



Bioinformatics

4 Credits
BIOL-404

Spring Semester, 2022

Faculty: Dr. Palmer Masumbe Netongo

Office: Nursing Building Room 213

Office Hours (face-to-face or online): Monday: 8:00-9:30 am.

Preferred Communication: Email and/or text; will respond within 24 hours

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Modality (face-to-face, hybrid, or online): face-to-face and hybrid

Class Location and Meeting Times (if face-to-face): Wet Lab 109/ MW: 9.30 AM -10.50 AM.

Meeting Hours and Online Hours (if hybrid): MW: 9.30 AM -10.50 AM

Lab Meeting Times: T: 11.00 AM -12.20 PM

Required Materials:

Textbook: Jin Xiong, Essential Bioinformatics, 2nd Edition (2006).

ISBN:9780521840989

Laboratory Manual: Jean-Michel Claverie, Cedric Notredame, “Bioinformatics For Dummies”, 2nd Edition, (2006).

ISBN: 978-0-470-08985-9

Tools: Pencils.

Lab Fee:\$125.00

Tools: Every student is required to have a laptop.

Mission, Vision, and Philosophy

Mission: Navajo Technical University honors Diné culture and language, while educating for the future.

Vision: Navajo Technical University provides an excellent educational experience in a supportive, culturally diverse environment, enabling all community members to grow intellectually, culturally, and economically.

Philosophy: Through the teachings of Nitsáhákees (thinking), Nahátá (planning), Íina (implementing), and Siihasin (reflection), students acquire quality education in diverse fields, while preserving cultural values and gaining economic opportunities.

Course Description: BIOL-404, Bioinformatics

The course is designed to allow contemporary biologists familiarize themselves with several bioinformatics programs and databases that would enable them to deal with numerous challenges posed by the genomic era. The course explains the basics of bioinformatics followed by discussion of current computational tools for solving biological research problems. Major themes in bioinformatics are covered, including biological databases, sequence alignment, gene and promoter prediction, molecular phylogenetics, structural bioinformatics, genomics, and proteomics. Prerequisites: BIOL-2110C, BIOL-2120C, BIOL-226, BIOL-302, and BIOL 2130C or

permission of the instructor. Offered: Spring.

The course will provide a concise yet comprehensive introduction of bioinformatics with specific orientation towards life science. The basics of bioinformatics will be explained, followed by discussions of the state-of-the-art computational tools available to solve biological research problems. All key areas of bioinformatics are covered including biological databases, sequence alignment, gene and promoter prediction, molecular phylogenetics, structural bioinformatics, genomics, and proteomics. The book emphasizes how computational methods work and compares the strengths and weaknesses of different methods. This balanced yet easily accessible text will be invaluable to students who do not have sophisticated computational backgrounds.

Course Objectives

After successfully completing this course, students should be able to:

1. Understand the basic notions in bioinformatics.
2. Become familiar with commonly used state-of-the-art computational tools available to solve biological research problems.
3. Understand major concepts and principles supporting biological databases, sequence alignment, gene and promoter prediction, molecular phylogenetics, structural bioinformatics, genomics, and proteomics.
4. Read and critique primary literature involving bioinformatics.
5. Apply knowledge to resolve common problems and to understand how computational methods work and compare the strengths and weaknesses of different methods. Emphasis will be laid on developing skills to apply the learned techniques to the understanding of scientific discovery (data interpretation and experimental design).

COURSE OUTCOMES	COURSE MEASUREMENTS
Understand the basic notions in bioinformatics	Understanding the basic notions in bioinformatics will be measured by class tests and quizzes, and exercises that present a scenario to resolve a particular problem using knowledge and techniques of bioinformatics.
Become familiar with commonly used state-of-the-art computational tools available to solve biological research problems.	Familiarity with commonly used bioinformatics laboratory techniques will be evaluated by quizzes, essays, oral presentations, homework and exams.
Understanding of major concepts and principles in bioinformatics	Understanding of major concepts and principles in bioinformatics will be analyzed by essays, oral presentation, observations of student's performance at tasks, quizzes, homework and exams.
Apply concepts and knowledge gained in bioinformatics to resolve common problems	Knowledge application will be examined by the students' ability to read and critique primary literature involving bioinformatics techniques, Examination, quizzes, poster and/or oral presentations, interpretation of case studies, homework assignments, lab write-ups, research papers, portfolios, and small group exercises would be used to measure outcomes.

Week	Date	Chapters	Assignment	Quiz
1	01/18-08/22	Module1: Introduction to Bioinformatics 1. What Is Bioinformatics? Goal, Scope , Applications, Limitations, New Themes / Lab 1	Read Pp. 1-8	
2	01/24/-01/29	2. Introduction to Biological Databases What Is a Database? Types of Databases Biological Databases Pitfalls of Biological Databases Information Retrieval from Biological Databases	Read Pp. 9-26	
	02/01	Quizz/Assignment on Chapters 1-2	Quiz	Chpt. 1-2
3	02/01-02/05	Module 2: SEQUENCE ALIGNMENT 3 Pairwise Sequence Alignment, Evolutionary Basis, Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity/ Lab 3a	Read pp 27-34	
4	02/07-02/12	3b: Methods: Scoring Matrices, Statistical Significance of Sequence Alignment / Lab 3b	Read pp. 35-49	
5	02/14-02/19	4a. Database Similarity Searching , Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with the Smith–Waterman Method / Lab 4	Read pp. 50-60	
	02/21	Holiday-President's Day		
	02/22	Quizz/Assignment on Chapters 3-4	Quiz	Chpt. 3-4
6	02/22-02/26	4b. Comparison of FASTA and BLAST, Database Searching with the Smith–Waterman Method / Lab 5	Read pp. 60-63	
7	02/28-03/05	5. Multiple Sequence Alignment, Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Practical Issues / Lab 6	Read pp. 63-74	
8	03/07-03/11	Midterm Exam Covering Chapters 10-11	Midterms	Chpt. 10-11
9	03/14-03/18	Spring Break		
10	03/21 - 10/26	6a. Profiles and Hidden Markov Models, Position-Specific Scoring Matrices, Profiles / Lab 7	Read pp. 75-77	
11	03/28-04/02	6b. Markov Model and Hidden Markov Model / Lab 8	Read pp. 78-79	
	04/05	Quiz on Chapters 5 -7	Quiz	Chpt. 5 -7
12	04/04-04/09	7. Protein Motifs and Domain Prediction, / Lab 9	Read pp. 80-91	
13	04/11- 04/16	Module 3: GENE AND PROMOTER PREDICTION 8. Gene Prediction / Lab 10	Read pp. 92-111	
14	04/18-04/23	9. Promoter and Regulatory Element Prediction / Lab 11	Read pp. 112-126	
	04/26	Quiz on Chapters 8-10	Quiz	Chpt. 8-10
14	04/25-04/30	Module 4: MOLECULAR PHYLOGENETICS 10. Phylogenetics Basics 11. Phylogenetic Tree Construction Methods and Programs / Lab 12	Read pp. 127-172	
16	05/02-05/07	REVISION	REVISION	REVISION
16	05/9	FINAL EXAMINATION	FINALS	

Grading Plan:

A = 100-90%
 B = 89-80%
 C = 79-70%
 D = 69-60%
 F = 59% or less

Allocation of Grades

Exams (Midterm & Finals)	40%
Homework/Presentations	10%
Tests/Quizzes	25%
Class participation	5%
Lab work	20%

Grading Policy

Students must do their own work. Cheating and plagiarism are strictly forbidden. Cheating includes (but is not limited to) plagiarism, submission of work that is not one's own, submission or use of falsified data, unauthorized access to exams or assignments, use of unauthorized material during an exam, or supplying or communicating unauthorized information for assignments or exams.

Participation

Students are expected to attend and participate in all class activities. Points will be given to students who actively participate in class activities including guest speakers, field trips, laboratories, and all other classroom events.

Cell phone and headphone use

Please turn cell phones off **before** coming to class. Cell phone courtesy is essential to quality classroom learning. Headphones must be removed before coming to class.

Attendance Policy

Students are expected to attend all class sessions. A percentage of the student's grade will be based on class attendance and participation. Absence from class, regardless of the reason, does not relieve the student of responsibility to complete all course work by required deadlines. Furthermore, it is the student's responsibility to obtain notes, handouts, and any other information covered when absent from class and to arrange to make up any in-class assignments or tests if permitted by the instructor. Incomplete or missing assignments will necessarily affect the student's grades. Instructors will report excessive and/or unexplained absences to the Counseling Department for investigation and potential intervention. **Instructors may drop students from the class after three (3) absences unless prior arrangements are made with the instructor to make up work and the instructor deems any excuse acceptable.**

Study Time Outside of Class for Face-to-Face Courses

For every credit hour in class, a student is expected to spend two hours outside of class studying course materials.

Study Time for Hybrid or Blended Courses

For a hybrid or blended course of one credit hour, a student is expected to spend three hours per week studying course materials.

Study Time for Online Courses

For an online course of one credit hour, a student is expected to spend four hours per week studying course materials.

Academic Integrity

Integrity (honesty) is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own. Students who engage in academic dishonesty diminish their education and bring discredit to the University community. Avoid situations likely to compromise academic integrity such as: cheating, facilitating academic dishonesty, and plagiarism; modifying academic work to obtain additional credit in the same class unless approved in advance by the instructor, failure to observe rules of academic integrity established by the instructor. **The use of another person's ideas or work claimed as your own without acknowledging the original source is known as plagiarism and is prohibited.**

Diné Philosophy of Education

The Diné Philosophy of Education (DPE) is incorporated into every class for students to become aware of and to understand the significance of the four Diné philosophical elements, including its affiliation with the four directions, four sacred mountains, the four set of thought processes and so forth: Nitsáhákees, Nahát'á, Íina and

Siih Hasin which are essential and relevant to self-identity, respect and wisdom to achieve career goals successfully.

At NTU's Zuni Campus, the A:shiwí Philosophy of Education offers essential elements for helping students develop Indigenous and Western understandings. Yam de bena: dap haydoshna: akkya hon detsemak a:wannikwa da: hon de:tsemak a:ts'umme. *Our language and ceremonies allow our people to maintain strength and knowledge.* A:shiwí core values of hon i:yyułashik'yanna:wa (respect), hon delank'oha:willa:wa (kindness and empathy), hon i:yyayumola:wa (honesty and trustworthiness), and hon kohoł lewuna:wediyahnan, wan hon kela i:tsemanna (think critically) are central to attaining strength and knowledge. They help learners develop positive self-identity, respect, kindness, and critical thinking skills to achieve life goals successfully.

Students with Disabilities

Navajo Technical University is committed to serving all students in a non-discriminatory and accommodating manner. Any student who feels that she or he may need special accommodations should contact the Accommodations Office (<http://www.navajotech.edu/student-services#accomodations-services>) in accordance with the university's Disability Accommodations Policy (see [http://www.navajotech.edu/images/about/policiesDocs/Disability Exhibit-A 6-26-2018.pdf](http://www.navajotech.edu/images/about/policiesDocs/Disability%20Exhibit-A%206-26-2018.pdf)).

Email Address

Students are required to use NTU's email address for all communications with faculty and staff.

Final Exam Date: May 9, 2021